

Areas of Faculæ and Sun-spots compared with Diurnal Ranges of Magnetic Declination, Horizontal Force, and Vertical Force as observed at the Royal Observatory, Greenwich, in the years 1873 to 1902.

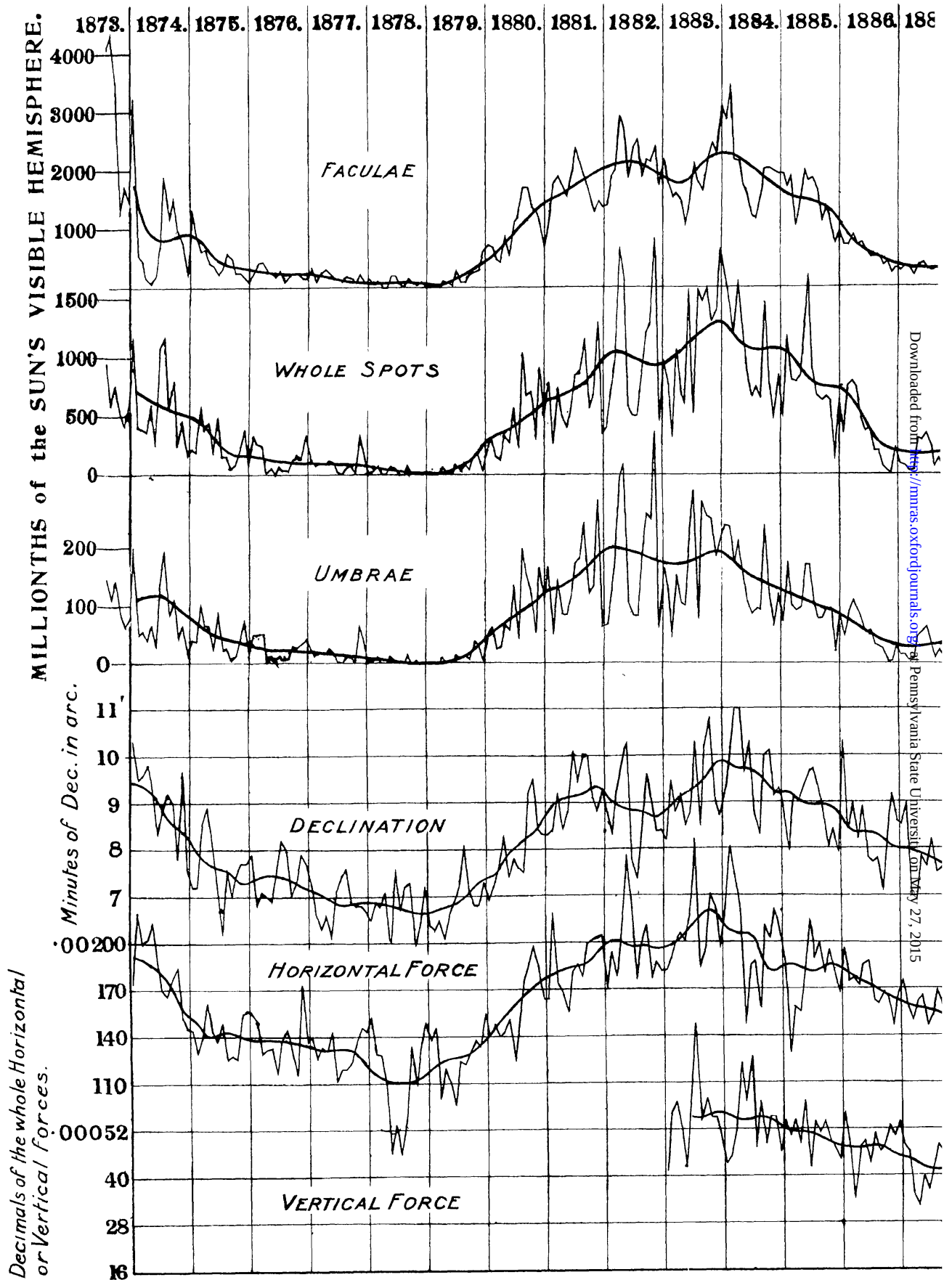
(Communicated by the Astronomer Royal.)

The following paper is an extension of one under a corresponding title communicated to the Royal Astronomical Society in November 1889 and printed in the *Monthly Notices*, vol. I. pp. 8-10. As in the plate accompanying that paper, which gave results up to 1888, so in Plate 16, attached to this, the three upper curves represent the areas of faculæ, whole spots, and umbrae respectively, and exhibit in a graphical form the results given on pages 106, 107, and 108 of the *Greenwich Spectroscopic and Photographic Results* for 1884, and in similar tables in the volumes for the succeeding years. For 1888 and subsequent years these results have also been communicated year by year to the Royal Astronomical Society, the figures for 1888 appearing in Table I. in the *Monthly Notices*, vol. xlix. p. 380. The mean areas for each of the three orders of solar markings have been formed by taking the means of the areas as measured upon the solar photographs, corrected for foreshortening, and reduced to millionths of the Sun's visible hemisphere for each day of observation throughout each synodic rotation of the Sun. The commencement of each rotation is defined by the coincidence of the assumed prime meridian with the central meridian, the assumed prime meridian being that meridian which passed through the ascending node at mean noon, on 1854 January 1, and the assumed period of the Sun's sidereal rotation being 25.38 days.

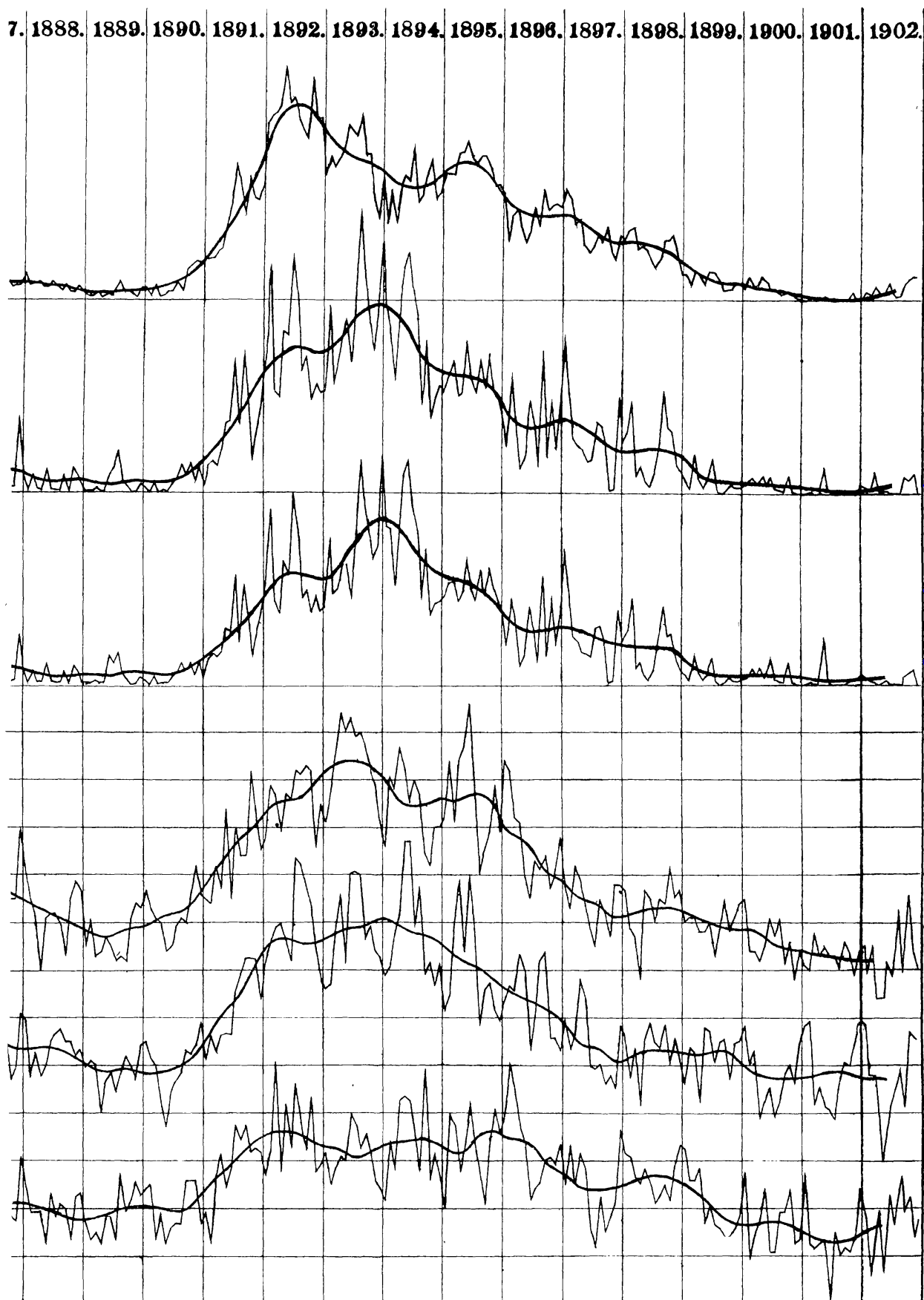
The ordinates for the three curves represent, therefore, the mean daily areas for each synodic rotation expressed in millionths of the Sun's visible hemisphere. The scale on which the ordinates have been drawn is five times as large for the nuclei as for the whole spots, and twice as large for the whole spots as for the faculæ, in order that the variations in each curve might be equally distinct; for the areas of the whole spots are, on the average, about five times as great as those of the nuclei, and of the faculæ rather more than twice as large as of the whole spots. A smooth curve has also been drawn for each of the three orders of phenomena, the ordinates for which correspond, at any given rotation, very nearly to the mean of the areas for the given rotation and the six preceding and following rotations, representing thirteen rotations, or nearly a year.

From 1873 to the end of 1881 only the photographs taken at the Royal Observatory, Greenwich, were available for measurement, but from 1881 December 21 the gaps in the Greenwich

AREAS OF FACULÆ AND SUN-SPOTS, COMPARED WITH DIURN
ROYAL OBSERVATORY, GF



AL RANGES OF MAGNETIC ELEMENTS AS OBSERVED AT THE EENWICH, 1873 TO 1902



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series have been filled as far as possible by photographs taken at Dehra Dûn, India ; and from the beginning of 1885 by photographs taken at the Royal Alfred Observatory, Mauritius, as well. The daily record for the years 1882 to 1902 may, therefore, be considered as practically complete.

The magnetic curves are constructed from Table XIV. in the annual volumes of Greenwich magnetic and meteorological observations, giving the monthly mean diurnal range for declination, horizontal force, and vertical force. The values for vertical force are not available until the year 1883 in consequence of difficulty with the temperature correction. The results, both for horizontal force and for vertical force, are corrected for temperature. Now the magnetic diurnal ranges are subject to an annual period, being greatest in summer and least in winter, the period being one which, depending on geographical position, has not necessarily any counterpart in the solar spot variation, and which, therefore, should be eliminated in order to make comparison with the Sun-spot curves. The mean monthly values of diurnal range having been found from the results for the years 1874 to 1891, for declination and horizontal force, and from the results for 1883 to 1901 for vertical force, the differences in each case between the several mean monthly values and the mean yearly value give corrections which, applied to the monthly values for any individual year, clear out the average annual inequality. In this way the curves of diurnal range of magnetic declination, horizontal force, and vertical force given in the plate are found.

The smoothed curves are formed as follows. Assuming equality in the length of the several calendar months in each element, the mean of the first twelve values is taken, then the mean of the second to the thirteenth value, the mean of the third to the fourteenth, and so on. Finally the mean of each adjacent pair of the means so formed is taken, from which resulting value the smoothed curve is formed.

The declination range is given in angular measure, and those of horizontal force and vertical force in parts of the whole horizontal and vertical forces respectively, the scales being so arranged that equal changes of absolute magnetic force are represented by an equal length of ordinate. 1' of declination corresponds to '0003 of horizontal force, and to $\frac{.0003}{\tan \text{dip}} = .00012$ of vertical force, the values adopted in setting out the various scales.

Royal Observatory, Greenwich :
1903 May 8.

Mean Areas and Heliographic Latitudes of Sun-spots in the year 1902, deduced from Photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn (India), and in Mauritius.

(Communicated by the Astronomer Royal.)

The results here given are in continuation of those printed in the *Monthly Notices*, vol. lxii. p. 378, and are deduced from the measurements of photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn, India, and at the Royal Alfred Observatory, Mauritius.

Table I. gives the mean daily areas of umbræ, whole spots, and faculæ for each synodic rotation of the Sun in 1902; and Table II. gives the same particulars for the entire year 1902, and the thirteen preceding years for the sake of comparison. The areas are given in two forms: first, projected areas—that is to say, as seen and measured on the photographs, these being expressed as millionths of the Sun's apparent disc; and next areas as corrected for foreshortening, the areas in this case being expressed in millionths of the Sun's visible hemisphere.

Table III. exhibits for each rotation in 1902 the mean daily area of the whole spots, and the mean heliographic latitude of the spotted area, for spots north and for spots south of the equator; together with the mean heliographic latitude of the entire spotted area, and the mean distance from the equator of all spots; and Table IV. gives the same information for the year as a whole, similar results from 1889 to 1901 being added as in the case of Table II. Tables II. and IV. are thus in continuation of the similar tables for the years 1874 to 1888 on pp. 381 and 382 of vol. xlix. of the *Monthly Notices*.

The rotations in Table I. and Table III. are numbered in continuation of Carrington's series (*Observations of Solar Spots made at Redhill*, by R. C. Carrington, F.R.S.), No. 1 being the rotation commencing 1853 November 9.

The assumed prime meridian is that which passed through the ascending node at mean noon on 1854 January 1, and the assumed period of the Sun's sidereal rotation is 25.38 days. The dates of the commencement of the rotation are given in Greenwich civil time, reckoning from mean midnight.

No photographs have yet been received for four of the days included in the preparation of the following tables, but the director of the Mauritius Observatory has reported that photographs were taken there on those occasions, and that they have already been despatched to England. He further reported that the Sun was clear of spots upon three of the days. For the remaining day, values have been assumed for the areas and positions of the spots by taking the means of those obtained for the day preceding and for that following.